frontiers

Supplementary Material

Blueprints of effective biodiversity and conservation knowledge products that support marine policy

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Supplementary Table 1. Overview of the status of each knowledge product with regards to the seven identified characteristics, ordered alphabetically (acronyms and references listed at the bottom of the table).

Knowledge product	Characteristic	Description
AquaMaps [1]	External policy mandate, recognition, and/or use in indicators or national government process	Recommended to be used to support expert-driven processes for species range delineation by e.g. 2 ICMMPA. Used for input in e.g. EBSA and IMMA (Important marine mammal area) delineation processes; used by IUCN MACBIO Ocean Wealth, and Ocean, Health Index with non-governmental, and intergovernmental organisations for marine spatial planning as partial input to measure ocean health and wealth.
	Standardised and documented methods, with quality assurance and comprehensive data coverage	Peer-reviewed, consistent methodology, available on their website. Global coverage, predicted long-term averages of species distribution for more than 25,000 marine species (~12,400 fish species and ~12,700 species of mammals, turtles and invertebrates), including forward projections using climate change scenarios
	Co-designed and user-friendly interface	User-friendliness of interface internally reviewed regularly and modified as needed; feedback on user-friendliness of interfaces also being requested from selected respondents (expert reviewers).
	Consistent capacity and succession planning	No published strategy or business plan. No core funding, but part of FishBase Information Network.
	Accessible data and value-added information that are fit-for- purpose	Annual updates of data used in the models; registration required to upload reviewed maps. Customized compilation of data sets available on request; some permission required on use of large/whole data sets to ensure data quality for purpose.
	Metrics of use collated and reported	AquaMaps statistics. Not externally reported.
	Established network of collaborators, experts, and monitoring sites	Established network of data providers, and some expert reviewers.
Global Biodiversity Information Facility (GBIF) [2]	External policy mandate, recognition, and/or use in indicators or national government process	Recommendation of the OECD's Biodiversity Informatics Subgroup of the Megascience Forum; endorsed by the OECD ministerial Committee for Scientific and Technological Policy. Indicator ("Number of GBIF records over time") for Aichi Target 19, with relevance to Targets 9 and 11-13. Recognised by the CBD as the leading source of primary biodiversity data.

Knowledge product	Characteristic	Description
	Standardised and documented methods, with quality assurance and comprehensive data coverage	Uses the extended Darwin Core Archive (DwC-A), which is a biodiversity informatics data standard that supports a stable standard reference for sharing information on biological diversity. Global coverage, but taxonomic bias towards terrestrial ecosystems. Graphs and information on trends in data completeness and potential biases available (e.g. seasonal, taxonomic).
	Co-designed and user-friendly interface	The GBIF Secretariat solicits feedback from node managers, data publishers and users to inform the development of the web interface, API and associated tools (e.g. Integrated Publishing Toolkit).
	Consistent capacity and succession planning	GBIF Implementation Plan 2017-2021 and Annual Work Programme 2017. Runs an annual capacity enhancement support programme and manages externally-funded grant programmes to support biodiversity data sharing and use in several regions.
	Accessible data and value-added information that are fit-for- purpose	All GBIF-mediated occurrence data are made available under one of three Creative Commons licenses: CC0, CC BY or CC BY-NC.
	Metrics of use collated and reported	DOIs fully integrated into workflow, and provided to data contributors. Annual publication of the "Science Review Sourcebook" and "Science review".
	Established network of collaborators, experts, and monitoring sites	Established network of more than 860 data-publishing institutions, coordinated through national- level nodes and thematic partners.
IUCN Red List [3]	External policy mandate, recognition, and/or use in indicators or national government process	Standard adopted by IUCN Council (C/51/35). Informs CITES, IPBES, and SDGs; indicator for Aichi Target 12, with application to Targets 4-11 and 14. Red List Index used to assess relative risk of extinction.
	Standardised and documented methods, with quality assurance and comprehensive data coverage	IUCN Red List Categories and Criteria Version 3.1, 2nd edition. Transparent assessment process, grounded in the peer-reviewed literature. Global coverage, with taxonomic bias towards terrestrial ecosystems.
	Co-designed and user-friendly interface	A new, user-oriented website will be built in 2017 and launched towards the end of the year. The new design is based on a lengthy consultation conducted in 2016 with key internal and external stakeholders.
	Consistent capacity and succession planning	The IUCN Red List of Threatened Species™: Strategic Plan 2013-2020. Version 1.0

Knowledge product	Characteristic	Description
	Accessible data and value-added information that are fit-for- purpose	Freely available for non-commercial use according to published terms, and under data licence for commercial use through IBAT.
	Metrics of use collated and reported	Annual reports highlighting assessments from the IUCN SSC Specialist Groups, spotlighting high-level interventions, and providing a summary of publications.
	Established network of collaborators, experts, and monitoring sites	IUCN SSC Specialist Groups.
Ocean Biogeographic Information System (OBIS) [4]	External policy mandate, recognition, and/or use in indicators or national government process	Adopted by IOC-UNESCO (IOC-XXV-4). Called upon by CBD (COP10/29), Mentioned by the United Nations General Assembly (UNGA) in 2014 (A/RES/69/245 paragraph 247), and contribution of OBIS to Marine Scientific Research acknowledged in 2015 (UNGA Resolution A/RES/70/235 paragraph 254), OBIS data and products used in UN WOA, GEF TWAP, CBD/EBSA, will inform IPBES global assessment and SDG14.
	Standardised and documented methods, with quality assurance and comprehensive data coverage	Darwin Core Archive (DwC-A), standard for species occurrence. OBIS published format within DwC-A for other data types: environmental and ecosystem data, tracking, and opting for linked data (De Pooter et al., 2017). Records are routinely quality controlled for errors (e.g. points on land), missing values, outliers (e.g. geographic, depth, temperature and salinity range), scientific names are matched with WoRMS taxonomic backbone etc. Global coverage, but bias towards Northern Hemisphere and coastal areas. All and only marine taxonomic groups. More global coverage took off since 1950s.
	Co-designed and user-friendly interface	New, more user-oriented, website launched in August 2016. New tools developed (e.g. API and R package). Further enhancement will happen in 2017 e.g. new products, GIS mapper, QC and analytical tools.
	Consistent capacity and succession planning	Integral part of UNESCO-IOC and long-term element of IODE programme (IODE exists since 1961). Core funding from UNESCO. Long-term commitment from VLIZ for hosting infrastructure. Several OBIS trainings organized per year to increase capacity. Need more resources for national and regional OBIS nodes.
	Accessible data and value-added information that are fit-for- purpose	Open-data policy: http://iobis.org/data/policy/. Area and taxon statistics available on exploration portal. Indicators and summary statistics: http://iobis.org/indicators/. Species trends, gaps and completeness indicators in development (e.g. http://iobis.org/2016/11/17/completeness/ and http://iobis.org/2016/11/15/occmod).

Knowledge product	Characteristic	Description
	Metrics of use collated and reported	Web metrics based on Google Analytics. OBIS cited papers listed at http://iobis.org/library/. Use cases documented at http://iobis.org/usecases/.
	Established network of collaborators, experts, and monitoring sites	Network of 600 data providing institutions, 27 national, regional or thematic OBIS nodes. Partnership with GEO BON MBON and GOOS Biology and Ecosystems. Seven OBIS task teams support the implementation of the work plan.
Ocean Data Viewer [5]	External policy mandate, recognition, and/or use in indicators or national government process	Mandated by CBD/COP 10 Decision X/29. Data downloaded by governmental, non-governmental, and intergovernmental organisations for marine spatial planning, risk assessments, and blue carbon and natural capital assessments. Used by the corporate sector (Proteus Partnership) for high-level screening.
	Standardised and documented methods, with quality assurance and comprehensive data coverage	Most datasets have gone through formal peer review; detailed metadata sheets have been developed that outline the intended uses, limitations, and licensing of each dataset. Quality varies between datasets due to differing methods and resolutions. Global coverage, but with taxonomic, temporal, and geographic gaps (differs by dataset).
	Co-designed and user-friendly interface	Feedback was sought from end users in the re-design of the Ocean Data Viewer, released in late 2014. End user consultation is planned for 2017 to inform the Ocean Data Viewer's continued development.
	Consistent capacity and succession planning	Curation costs not core-funded. No published strategy or business plan (currently in development).
	Accessible data and value-added information that are fit-for- purpose	Commercial use restriction (UNEP-WCMC General Data License); redistribution allowed under a specific license. Data updated on an ad hoc basis. Data requirements established in consultation with end users.
	Metrics of use collated and reported	Google Analytics, shortlinks (http://wcmc.io), and user information, including intended use, collected. Not externally reported.
	Established network of collaborators, experts, and monitoring sites	No external reporting, and variable network of contacts.
Protected Planet [6]	External policy mandate, recognition, and/or use in indicators or national government process	Mandated by the United Nations (e.g. numerous CBD/COP Decisions); ECOSOC Resolution 713 (XXVIII). IPBES core indicator, and relevant indicator for Aichi Target 11 and SDGs, notably Targets 14.5.1, 15.1.2, and 15.4.1. Used by the corporate sector (Proteus Partnership) for high-level screening.

Knowledge product	Characteristic	Description
	Standardised and documented methods, with quality assurance and comprehensive data coverage	World Database on Protected Areas Manual v1.3. Data reported by government authorities and other authoritative sources. Data standardised and published by UNEP-WCMC. Global coverage (>230,000 protected areas from >240 countries and territories). 87% of records have been updated in the past five years.
	Co-designed and user-friendly interface	User feedback compiled and used to re-design the recent version (released in 2014; enhanced in 2015).
	Consistent capacity and succession planning	Curation costs not core-funded.
	Accessible data and value-added information that are fit-for- purpose	Commercial use restriction (UNEP-WCMC WDPA Data Licence); redistribution allowed under a specific license. Data updated monthly. Data requirements established in consultation with end users.
	Metrics of use collated and reported	Google Analytics and shortlinks (http://wcmc.io).
	Established network of collaborators, experts, and monitoring sites	Established network of national contacts (governmental authorities, authoritative sources).
Species+ [7]	External policy mandate, recognition, and/or use in indicators or national government process	Developed to assist Parties with implementing CITES, CMS and the European Union Wildlife Trade Regulations, helping to inform decisions on species of global concern.
	Standardised and documented methods, with quality assurance and comprehensive data coverage	Follows the taxonomies agreed by the Parties of CITES and CMS. Reflects the decisions of these MEAs, and of the European Union Wildlife Trade Regulations. Taxonomic and legal information for CITES and the EU Wildlife Trade Regulations are fully up-to-date.
	Co-designed and user-friendly interface	Bespoke product built in consultation with the CITES and CMS Secretariats and the European Commission, with ongoing development.
	Consistent capacity and succession planning	Financial support has come from a range of sources. Current funders, supporting maintenance include: WCMC (UK), the European Commission and the CITES Secretariat.

Knowledge product	Characteristic	Description
	Accessible data and value-added information that are fit-for- purpose	Commercial use restriction (UNEP-WCMC General Data License); redistribution allowed under a specific license. Updates made on a regular basis. Data requirements established in consultation with end users.
	Metrics of use collated and reported	Google Analytics. Reported to partners and collaborators.
	Established network of collaborators, experts, and monitoring sites	Established network of partners, national government contacts and taxonomic experts.
World Database on Key Biodiversity Areas [8]	External policy mandate, recognition, and/or use in indicators or national government process	"A Global Standard for the Identification of Key Biodiversity Areas" established based on IUCN Resolution WCC 2004 Res 3.013; application in indicators for CBD, SDGs, etc.
	Standardised and documented methods, with quality assurance and comprehensive data coverage	Follows "A Global Standard for the Identification of Key Biodiversity Areas"; workflow includes processes for peer review and petition. Global data coverage, but with substantial gaps in taxonomic and ecosystem data coverage.
	Co-designed and user-friendly interface	Explicit end-user consultation in development of the Standard; formal Key Biodiversity Areas Consultative Forum
	Consistent capacity and succession planning	Data flow from national institutions. Strategic plan under development.
	Accessible data and value-added information that are fit-for- purpose	All data available online, except for redistribution. Terms of use require licensing through IBAT for commercial applications.
	Metrics of use collated and reported	Under development.
	Established network of collaborators, experts, and monitoring sites	Data contributed by hundreds of national institutions (and thousands of individuals).

Knowledge product	Characteristic	Description

[1] Kesner-Reyes et al., 2012; Ready et al., 2010; Hoyt, 2012
[2] BIP, 2010c; GBIF, 2010; Gaiji et al., 2013; Robertson et al., 2014; GBIF, 2017a,b,c
[3] BIP, 2010b; Brooks et al., 2015, 2016; Butchart et al., 2005; IBAT, 2015; IUCN, 2015; Mace et al., 2008; IUCN Species Survival Commission, 2012
[4] De Pooter et al., 2017
[5] UNEP-WCMC General Data License (excluding WDPA) (https://www.unep-wcmc.org/policies/general-data-license-excluding-wdpa)
[6] BIP, 2010a, 2010d; Brooks et al., 2015, 2016; Juffe-Bignoli et al., 2016; UNEP-WCMC WDPA Data License (https://www.unep-wcmc.org/policies/wdpa-data-licence#data_policy)
[7] UNEP, 2017
[8] IUCN, 2016

Acronyms: Convention on Biological Diversity, CBD; Convention on International Trade in Endangered Species of Wild Fauna and Flora, CITES; Convention on the Conservation of Migratory Species of Wild Animals, CMS; Conference of Parties, COP; Digital Object Identifiers, DOIs; United Nations Economic and Social Council, ECOSOC; Global Environment Facility, GEF; Group on Earth Observations Biodiversity Observation Network, GEO BON; Global Ocean Observing System, GOOS; International Committee on Marine Mammal Protected Areas, ICMMPA; Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization, IOC-UNESCO; International Oceanographic Data and Information Exchange, IODE; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, IPBES; International Union for Conservation of Nature Species Survival Commission, IUCN SSC; Marine Biodiversity Observation Network, MBON; Organisation for Economic Co-operation and Development, OECD; United Nations General Assembly, UNGA; Flanders Marine Institute, VLIZ; Sustainable Development Goals, SDGs).

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